

*Breakout Group 1:*  
Summary of Discussion

# Outline

- Results of a Quick Vote
- One “Special” Topic
- Task Allocations
- Research Directions & Suggestions

# A Quick (Anonymous) Vote

- *Purpose:* To obtain a general sense of opinions represented by this group
- Only 8 Present for Vote
- Asked for personal, informed opinion at present time
- **General Categories Presented**
  - Need 2 Traditional Pilots
  - Strive for 1 Pilot
  - Strive for 1 Pilot on Ground and 1 Pilot in Air
  - Strive to Move Directly from 2 Pilots to None

# Results of the Vote

- Need 2 Traditional Pilots [1]
- Strive for 1 Pilot [1]
- Strive for 1 Pilot on Ground and 1 Pilot in Air [5]
- Strive to Move Directly from 2 Pilots to None [1]

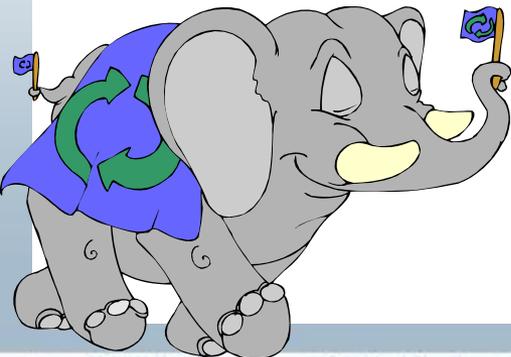
# Initial Approach

- Presented participants with 2 questions to consider as we reviewed the sheet summarizing typical flight deck crew responsibilities:
  1. How would functions/tasks be affected by removing a crew member?
  2. How might a new allocation strategy be used to counter the effects identified in #1.

**BUT...**

**They wouldn't let us ignore  
the elephant in the room...**

**PILOT INCAPACITATION**



# Pilot Incapacitation

- Most participants felt this issue is **extremely important**.
  - It affects *every* item on the list of responsibilities.
  - Statistics comparing single-pilot vs. two-pilot crew were striking
- Several remarks were noted that suggest we may be overemphasizing this issue.

# Pilot Incapacitation

- Two Major Themes in Discussion
  1. What should incapacitation be *conceived or defined*?
  2. How should incapacitation be *monitored and determined*?

# Pilot Incapacitation: *Defined*

- Physical *and* Mental Health
  - Specific examples presented:
    - Death
    - Unconsciousness
    - Sleeping
    - Drug Use
      - Prescription meds should NOT be ignored
    - Mental instability
- Incapacitation may be progressive
  - That is, incapacitation does not necessarily have sudden (all-or-none) impact

# Pilot Incapacitation: *Monitoring and Determination of State*

## ● **Monitoring**

- Without a second pilot, **mental health** may be extremely **difficult** to monitor with any level of assurance.
- **Physical health** may be **relatively easier** to monitor in the absence of a human.
- Should be approached with recognition that incapacitation **may have early symptoms** (progressive incapacitation)

# Pilot Incapacitation: *Monitoring and Determination of State*

- **Determination of State**

- Most seemed to believe that a **human should be involved** with this portion of the process.
  - The human who makes the decision does not necessarily have to be a second pilot in the cockpit (e.g., pilot on ground).
- **Extreme caution should be taken if either of these concepts are pursued:**
  - **Automation (technology) is used to decide** if a pilot is incapacitated.
    - As noted during one of the presentations, there would be no tolerance for error in either direction (false alarm or miss)
  - **“Locking out” the onboard pilot** from control of the aircraft.
    - Perhaps automation should “kick in” when a decision needs to be made immediately.

# Pilot Incapacitation: *For Consideration*

- Be proactive in requiring **more sophisticated medicals.**
- Consider **model used for DUIs**
  - Notification system if the pilot in front of you is behaving oddly (suspect incapacitation)
- Air carrier side almost always has **pilot in the back.**
  - Take advantage of this situation.

# The Question of Task Allocations

- We attempted to do what was asked of us during the morning session:
  - *Brainstorm regarding different allocation strategies etc*
- We found it difficult to work with the **specific responsibilities** of the current flight deck crew (handout for participants)
- Rather, more general notions were shared and were believed to better reflect the problem at hand.

# Tasks that Should Be Reserved for the Remaining Single Pilot

- Visuals
  - E.g., see and avoid, visual separation, looking at on-board weather radar
- Higher-order decision making
  - Multiple failures
  - Novel problems
  - Collision avoidance
  - Strategic planning, in general
- Tasks that require “experiencing” a state (e.g., turbulence)

# Additional Thoughts Regarding Task Allocations

- **Impact on “Aviate” category is minimal in move to SPO**
  - “Navigate” & “Communicate” categories represent the co-pilot and best reflect the change.
- **FOCs/AOCs may be able to pick up a big chunk of the flight planning**
  - May even include weather
- **Pilot is legally responsible for flight.**
  - Must consider changing legal responsibilities.
    - Is automation another collaborator in the system?
      - If so, who is responsible?
- **Pilot responsibilities might be de-centralized in SPO.**
  - There are some advantages to decisions based on centralized (local) information
- **NextGen** giving pilots more responsibility (freedom), but SPO would remove a pilot from that system

# Research Directions & Suggestions

- Generally, we were surprised at the amount of **literature review** that was **suggested** when all was said and done.
- Other than this general observation, the **following slides** represent many of the **research areas that were discussed**, in no particular order.

# Research Directions & Suggestions

- Define **what is meant by “risk”** in SPO, where risk is conceptualized as risk imposed by real-time choices made.
- Systematically **identify what the co-pilot monitors today**, and only thereafter, identify how that can/should be allocated?
- How can the **state of all “parties” be transparent?**
  - What is the state of the **automation?** State of the **SP?** How are these states transparent to those on the **ground?**

# Research Directions & Suggestions

- **What visual (body language) cues are being used between pilots?**
  - Try the experiment suggested during the presentations (partition between pilots)
- Explore the **effects of fatigue/boredom on the SP & whether it creates automation overreliance**
  - Lack of social pressure to “stay on the ball?”
- Consider **“automation” using several taxonomies**
  - Traditional **“levels”** of automation
  - Think about how tasks can be **shared/blended or distributed.**
  - Consider **adaptive and adaptable automation.**
    - Any automation this is consistently performed by the software may be relatively less worrisome compared to dynamic allocations.

# Research Directions & Suggestions

- **How do we chose particular tasks to automate and why?**
  - When we think in terms of tasks do we miss “chunks” in tasks?
    - Are some tasks necessarily “tied” and it would be ineffective to distribute them?
    - Tasks, as defined, should be meaningful
  - By re-allocating tasks, do we change the nature of job in ways that are unforeseen (tasks might disappear or might be created)?
- **Identify tasks at which humans excel vs. at which technology excels**
- **Why not think about automation as a means to enable needed capabilities in SPO?**
- **Develop Concept of Operations**
  - Lay out numerous alternatives (paths) and receive feedback
  - May allow you to save tine/effort before too many resources are spent going down the “wrong” path

# Research Directions & Suggestions

- **Poll aviation community** to determine which Single Pilot scenario for Part 121 operations is viable.
- **Explore the military domain** and leverage off of their experience in single-pilot/dual-pilot vehicle operations
- **Assess political/passenger acceptance** issues of Single-Pilot 121 ops.

# Research Directions & Suggestions

- Consider **multiple measures of performance** (do not limit to incident/accident)
- Consider the **means by which the pilot will communicate his/her intentions**

# Research Directions & Suggestions

- **Literature Review/Background Research (Non-experimental)**
  - Pilot monitoring (see DARPA research)
  - Review Jay Shively's chapter regarding how tasks can be organized
  - Kathy Abbott's upcoming report
  - 1981 ASRS study (single pilot IFR)
  - Safety analysis
    - How/when has the second pilot mitigating the problem?
  - Review NextGen Concept of Operations
  - Review accidents/incidents that are a result of design assumptions
    - Assist us in guarding against the overuse of engineers in making assumptions about real-time situations
  - Review insurance issues (see member of Ames community)
  - Explore FARs related to oxygen requirements for current single pilot operations (e.g., 1 pilot exits cockpit) as it applies to SPO
  - Review work from task force from when we moved from 3 to 2 pilots

# Research Directions & Suggestions

- Spend time scoping the problem!!
- There is MUCH to explore for the SPO concept.